LECTURE 4 19 March 1988

1. TECHNOLOGY AND DEVELOPMENT

1.1. The Record

Over the past 35-40 years, a large number of countries, particularly in Asia and Africa, achieved political independence, and set out on the path of economic transformation. A large number of industries were established: a great deal of modernization occurred with the introduction of western food, clothing and houses, hospitals, universities, cars, airlines, telephones, radio, television, etc. At the same time, many of these countries sought to modernize their agriculture, particularly through the so-called "green revolution" based on high-yielding varieties and large inputs of fertilizer, pesticides, water, etc. The Gross National Product (a measure of the amount of goods and services produced by the country) has shown impressive increases in most of these countries.

1.2 The Underlying Assumption: Trickle Down

This pattern of transformation was inspired by a simple belief, viz., all that a backward country needed to do to develop was to retrace the path followed by the industrialized countries and to adopt the goals which they pursued. In particular, the aim should be to maximize growth in the volume of goods and services, i.e., to maximize the GNP. By implementing such a strategy, it was assumed that the acute poverty of the masses in developing countries would be eliminated by the benefits of growth trickling down to the poorest sections of society.

1.3 The Result: Dual Societies

By now, sufficient time has elapsed to see the results of such a growth-and-trickle-down strategy. The main result has been the consolidation of small islands of urban splendour amidst vast oceans of rural misery, and the perpetuation and aggravation of what has been termed a "dual society" -- a small politically powerful elite (constituting a mere 10-15% of the population and consisting of industrialists, landlords, bureaucrats, professionals and white-collar labour) living in conspicuous affluence amidst the abject poverty of the politically weak masses. Recent history also shows that, in most of these backward countries, the greater the industrialisation on the pattern of the advanced countries, the greater the polarization into a dual society, and the wider the gap between the elite and the masses.
It is not even clear whether the percentage of people pushed below the poverty line has decreased.

1.4 The Instrument: Technology

The sole beneficiaries of a dual society seem to be the sections of society belonging to the elite. It is reasonable therefore to infer that it has deliberately sought to perpetuate such a society.

The submission here is that a major instrument of the elite has been technology, which has been liberally imported from the industrialized countries, and sometimes naturalized by a process of imitation and adaptation in the well-known import substitution drives. This submission follows -- as shown below -- from the model for the interaction between technology and society presented in Lecture 1.

1.5 The Western Pattern of Technology

The cultural and intellectual dominance of the industrialized countries over the developing countries has been so overwhelming that any thought of development automatically conjures up a picture of the pattern of technology (which for convenience shall be referred to as western technology) that obtains in the market economies of western Europe and North America. This picture is only reinforced by the fact that the centrally planned economies of Eastern Europe and Soviet Union, the industrialized country of the East, Japan, and the newly industrializing countries such as South Korea have also adopted virtually identical patterns.

A fundamental question, therefore, arises, is the western pattern of technology a unique, inevitable and unavoidable pattern which developing countries must necessarily follow?

In exploring this question, it must first be realized, following from the model of technology-society interactions presented in Lecture 1, that, like all patterns of technology, the current western pattern of technology is also a product of specific historical conditions, viz., the epoch of history corresponding to the past 30-80 years.

In this epoch, a set of industrialized countries were first able to control the politics of a number of colonies, and then after these countries became politically independent, to dominate the economies of these ex-colonies. These relationships of dominance enabled the industrialized countries to commandeer, and/or enjoy from the developing countries, natural resources, including non-renewable minerals and fossil-fuel energy, at much lower prices than would have been the case if relationships of equality had prevailed. This is why the prices of raw materials

from the Third World have not risen as sharply as the prices of manufactured goods from the industrialized countries. (The 1973 oil price hike and the conflicts at UNCTAD and the North-South Conferences are all part of the drive to redress these historically-enforced inequalities.)

This situation also resulted in the accumulation of capital taking place in the industrialized countries at rates and in volumes which would not have otherwise been possible. At the same time, the industrialization of the industrialized countries has invariably taken place amidst shortages of labour.

All these factors, i.e., the easy availability and low prices of raw materials, energy and capital, and the scarcity of labour, have had an overwhelming influence on the pattern of western technology. This is because every technology is only viable within certain limits (upper or lower) of the prices of raw materials, energy, capital and labour, and if the prices of one or more of these inputs changes drastically, the validity of the technology may be undermined. The point has been dramatically demonstrated with the vast number of energy-intensive western technologies based on the cheap Middle East oil of the pre-1973 days, all of which are now undergoing thorough reassessment. Thus, the old (and still prevailing international economic order) has resulted in the capital intensiveness, energy-profligacy, recklessness with regard to non-renewable natural resources, and labour-saving character of the western pattern of technology.

The second crucial feature of the period of history which spawned the western pattern of technology is that the vast majority of the technological innovations underlying this pattern have emanated from the basic driving force of capitalism, viz., the maximization of profit and accumulation. This intrinsic compulsion to minimize internal costs of enterprises and to disregard as externalities all effects on the social and natural environment of the enterprises has led to the three intrinsic tendencies of western technology:

(1) amplification of inequalities between and within countries;
(2) increase of alienation of men from each other and from their work, and diminution of social participation and control; and
(3) degradation of the environment.

The intrinsic tendency of amplifying inequalities between and within countries results from the following features.

(1) Western production technology has become increasingly capital-intensive, and therefore gravitates to areas and locations where that capital can be mustered and exploited, i.e., usually towards rich nations and away from poor nations, and towards the urban areas of developing countries at the expense of their villages.

(2) The associated increase in energy intensiveness leads to increasing automation and decreasing dependence on labour, i.e., in the absence of careful planning, to greater unemployment. This produces, in industrialized countries, relative poverty for the minority and, in developing countries, a potentially catastrophic accentuation of the gap between affluent elites and the poverty-stricken masses.

(3) Having largely solved the minimum needs of the populations in industrialized countries, western product technology is increasingly oriented towards luxury goods for private consumption, and towards military applications. For, when there is inequality in the distribution of purchasing power, the resulting skewed demand structure drives such technology to respond more avidly to the luxury demands of the rich and to other non-essentials, and assign lower priority to the basic needs of the underprivileged.

The inherent tendency of increasing alienation and diminishing social participation and control is an inevitable result of the following features.

(1) Western production technology has relentlessly pursued so-called economies of scale, mass production and automation. In doing so, it has generated a highly skewed pattern of demand for skills. Only the few are required to possess a high degree of intellectual training or manual skills, while the barest minimum of intelligence and dexterity is expected from the vast majority of the working force, which naturally becomes alienated. This trend is only aggravated by the deliberate organization of the labour process to increase profits, rather than to enrich the lives of workers.

(2) But, training and skills lead to control over technology, and thereby to power -- hence, western technology tends to concentrate power in the hands of the few and deprive the majority of control over their destinies. Push-button warfare is the ultimate example of the technology-power equation.

(3) The virtually complete exclusion of craftsmanship and creativity from work in modern factories which are, in addition, dominated by machines, results in the alienation of men from their work.

(4) Western product technology is specifically designed to respond to and evoke demands from, those privileged with purchasing power, and therefore results in the proliferation of luxury goods for individual consumption and the generation of

overly consumption- oriented lifestyles -- thus increasing alienation of men from other men.

The third intrinsic tendency of the western pattern of technology, viz., its disastrous impact on the environment, is a consequence of the following features.

(1) Western industry's obsession with an ever-increasing scale of production results in an increasing magnitude of perturbation of ecosystems (e.g., the sources of pollution become more and more concentrated and intense) till there is a real possibility of pushing them beyond the limits of stability.

(2) Western industry has generated risks to the biosphere of increasing gravity ranging from trivial and acceptable to remediable, avoidable and catastrophic, and has increased the probability of occurrence of any given category of risk. Thus, human civilization and life itself have become threatened by technological "progress", particularly in weapons.

(3) At the same time, the constant drive to manufacture products, which are ever changing in appearance and form, but similar in function and content, is the cause of the rape and exhaustion of natural resources, the alarming degree of product obsolescence and the "throwaway" philosophy.

(4) Finally, the tendency of western technology to magnify inequality results in the very rich countries (and the rich groups within poor countries) damaging the environment through over-consumption, and the very poor being able to ensure their survival only at the expense of their environment.

1.6 The Need for an Alternative Pattern of Technology

In considering the industrialization of developing countries, two fundamental issues must be raised:

(1) is it feasible for these countries to emulate the western pattern?

(2) is it just and moral to do so?

The feasibility aspect is easily considered by noting that developing countries like India just cannot replicate the favourable environment which the industrialized countries enjoyed, particularly during the early stages of their industrialization.

Very, very few of the developing countries have within their frontiers the entire range and quantity of raw materials necessary for the western pattern of technology. Barring the

OPEC countries, most of them are critically short of energy. Most of their agricultural systems have been distorted into production of commercial crops for the industrialized world resulting in frequent food deficits. They do not have captive external markets for manufactured goods, and in attempting the export drives being recommended to them, they find that their industrial technologies are either not competitive with those from the industrialized countries, or when they are, they are faced with a rising tide of protectionism. Finally, developing countries often find that it is too costly to generate indigenous technologies that are competitive. Hence, they are forced to import western technology. And when they do so, they learn that technology exports from industrialized countries have become a new mechanism way of reinforcing and aggravating the dependence of developing countries.

The current predicament of a developing country can be simply described thus: a country cannot arrive on the stage of history fifty years late and expect to play the same role as the countries which participated in the first acts.

Even if it were feasible for developing countries to emulate the western pattern of technology, the justice and morality of such an attempt should be considered.

The whole pattern of inequality, injustice and exploitation characterizing the current international economic order is repeated within developing countries, for almost all of them are polarized into dual societies with a society of the richest 10-15% of the population separated by a vast chasm of lifestyles, incomes and aspirations from a society of the poorest 85 consisting mainly of the rural poor. The market economy encompasses almost exclusively the richest 15% which has emerged as a politically powerful, conspicuously consuming, western-oriented elite. At the same time, the poorest 85%, and in particular the poorest 40-50%, exist in poverty outside the market economy. The polarization is also associated with rural stagnation and impoverishment, with massive rural employment and underemployment, and with mass migration to metropolitan slums. Hopes that the benefits of industrial growth will percolate to the countryside and reduce income disparities have not been borne out by experience.

In fact, it appears that the western pattern of technology (upon which Indian industrialization has been based) has only accentuated the evils of the dual society.

The elite, however, is the principal beneficiary -- through the luxury goods, jobs, perquisites and profits -- of the

introduction of the western pattern of technology. When this capital-intensive, labour-saving pattern is introduced into capital-starved, manpower-rich developing countries, the scarce capital concentrates in large urban plants and shies away from the rural economy. One result of this concentration of capital is a sharpening of the contrast in living standards and opportunities between the urban elite and the rural masses.

Another result which has to be singled out from all the others as particularly alarming is the impact on employment. Because of the capital-intensive nature of western technology, the investment required to create jobs is extremely high, about Rs.15,000 - 1,50,000 per job in India. At this rate, industrialization on the basis of western technology can provide employment only to restricted numbers. The backlog of unemployed (about 30 million), and the new entrants to the work-force every year (about 5 million in India), cannot find employment through labour-saving western technology unless astronomically large investments are made. But, these are impossible in capital-starved developing countries. Hence, unemployment grows to serious proportions.

It is clear that the western pattern of technology and industry sustains and consolidates the elite. In turn, the elite has consistently supported the adoption and promotion of this pattern, for example, through the policy of foreign collaboration arrangements.

Thus, the western pattern of technology has buttressed the polarization into dual societies with small city-oriented western elites, and large masses of poor people left out of the circle of production and consumption by the lack of employment and purchasing power. In short, the pursuit of the western pattern has created and bolstered small enclaves of western-oriented affluence, but the enclaves can survive only if they do not expand significantly.

Further, as is the situation between industrialized and developing countries, the haves can <u>have</u> only if the have-nots do <u>not</u> have, in the sense that the affluence of the elites can be preserved at the expense of the misery of the masses. Such disparity cannot be associated with stability; it can be maintained only by force. Thus the exploitation, injustice and misery inherent in dual societies implies the immorality of the western pattern of technology.

Hence, not only is the western pattern not feasible; it is also immoral. But interestingly, what is immoral cannot be sustained, and what is not feasible over the long run is also immoral. Historical feasibility and morality seem to converge.

An alternative pattern of technology must be implemented.

2. THE CONCEPT OF APPROPRIATE TECHNOLOGY

2.1 The Problem of Defining Appropriate Technology

It is against this background that the clamour for an alternative pattern of technology -- appropriate technology -- has been raised. The arguments for appropriate technology have been slowly mounting for over half a century. But, what is appropriate technology?

Before seeking an answer, it must be realized clearly that the word "appropriate" has no meaning in itself, unless one specifies "appropriate to what?". The point is that technology is only an instrument, but like all instruments, it must be fashioned (i.e., made appropriate) to achieve the purpose for which it is intended. So, the definition of the word "appropriate" must emerge from the purpose of technology in developing countries like India. Stated thus, it is obvious that since development is the objective and technology is the instrument, technology must be appropriate for development.

2.2 Development = Needs-oriented, Self-reliant, Environmentally Sound Growth

The experience of the past 40 years shows that development must not be equated with growth. Far more important than the sheer magnitude of growth is the structure and content of growth, and the distribution of its benefits. Once a particular pattern of growth takes place, neither its structure and content, nor its benefits, can be easily altered. Growth for the benefit of the elite, e.g., processed and packaged foods, expensive cloth, luxury houses, capital-intensive private hospitals, richly-endowed universities, and private cars, cannot be transformed easily into growth for the masses, i.e., cheap food and cloth, low-cost housing, mass health care, education and transportation. The GNP by itself does not reveal what constitutes it, e.g., cars or buses?, or who benefits by it, i.e., the elite or the masses?

Development must be defined, not merely as growth, but as a process of socio-economic change principally directed towards:

(1) satisfaction of basic human needs (food, clothing, shelter, health, education, transport/communication, etc., and employment which makes all this possible), starting from the needs of the neediest, in order to reduce inequalities;

(2) social participation and control in order to strengthen a self-reliance that grows from within; and
(3) ecological soundness in order to achieve harmony with the environment and make development sustainable over the long run.

This view of development is totally different from a simple GNP-maximizing approach -- whereas the former is concerned primarily with human beings, the latter is preoccupied with goods and services. The former is deliberately directed towards the neediest (who are incidentally the majority in developing countries), whereas the latter hopes that benefits will spontaneously trickle down to those underprivileged. According to the development-oriented approach, what goods and services are produced is of central importance, but this question is of little concern in the GNP-maximizing approach.

2.3 Appropriate Technology = Development-advancing Technology

It is from this standpoint of development that appropriate technology must be defined. Appropriate Technology should be defined as technology that advances development objectives, i.e., appropriate technology is technology which promotes

(a) the satisfaction of basic human needs, starting from the needs of the neediest;
(b) social participation and control; and
(c) ecological soundness.

The test for the appropriateness of technology is whether it faciltates

(a) the reduction of inequalities;
(b) the strengthening of self-reliance; and
(c) harmony with the environment.

2.4 Comparison with other Definitions of Appropriate Technology

This view of appropriate technology according to which it is linked to the development process can now be compared with five other approaches which are current, viz.,

(1) the area approach,
(2) the factor-endowment approach,
(3) the resource-endowment approach,
(4) the target-group approach, and
(5) the market-expansion approach.

According to the area approach, appropriate technology is technology that is appropriate to the area/region of interest, i.e., to the village, cluster of villages, district, region or nation. Such an area-based criterion of appropriateness ignores the fact that societies are stratified and that, while particular technologies can be appropriate to the region in which a society lives, their benefits may flow overwhelmingly to the richest and most powerful sections of that society, and thus amplify its inequalities. Since such an impact negates development, it means that what is appropriate to a area may not necessarily be appropriate for development.

The factor-endowment approach is based on the view that appropriate technology is technology that is appropriate to the factors of capital and labour which the area is endowed with. Thus, in a capital-short, man-power rich country, appropriate technologies should be capital-saving and labour-intensive. While such an approach ensures employment-generation and manpower utilization, it ignores the product-mix question, i.e., what mix of goods and services are produced and whether such a mix satisfies the basic needs of the neediest. Since it is easy to imagine luxury goods for the elite in poor countries and/or for export to the rich countries being produced in a capital-saving labour-intensive way, it is clear that the factor-endowment approach leads to an important part of the definition consistent with development, but not to the whole definition. In other words, technologies can be appropriate to the country's endowments of capital and labour, but inappropriate for development.

The limitations of the resource-endowment approach are similar. While technologies appropriate for development must as far as possible be based on local resources, it is quite possible that technologies attuned to resources can be inconsistent with development. For instance, the manner of production may not appropriate to the capital-labour endowments or the products that are produced may not be relevant to the neediest sections.

The emphasis on what products are produced and whose needs they satisfy is therefore of fundamental importance. This emphasis is safeguarded in the target-group approach according to which appropriate technology is technology that is appropriate to the needs of the underprivileged sections of society. This target-group approach comes closest to the development-oriented definition of appropriate technology proposed above, but unfortunately it facilitates a narrow and short-sighted view in which remote and long-term linkages to the basic needs of the target groups are ignored. For instance, <u>exclusive</u> concern with the <u>immediate</u> needs of the weakest sections may lead to absence

or insufficiency of attention on basic goods and infrastructure, e.g., steel transport and power. Thus, the weakness of the target-group-based definition of appropriate technology is that it may restrict the time-horizon over which appropriateness should be considered. In contrast, the development-based definition of appropriate technology not only facilitates a balanced concern over long- and short-term development objectives, but also protects the interests of the target group by its emphasis on "starting from the needs of the neediest".

Finally, there is an insidious definition of appropriate technology which equates it with technologies that integrate rural areas with the urban market. This definition implicitly assumes that such an expansion of the urban market into new areas is always beneficial to the new areas irrespective of the "terms of trade" between them. This definition ensures growth, but it may not promote development.

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